Space Weather Technical Forecast

Issued on Thursday, 26 May 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts. Slight chance of G1/Minor Storms on 26th and 27th.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with an M1.3 at 25/1824UTC emanating from the region of ex-AR3016, which was accompanied by a potentially Earth-directed CME. This will be analysed as more imagery becomes available. AR3014 (Dkc/βγδ) and AR3017 (Dsi/βδ) in the northwestern quadrant are both rotating towards the western limb, with neither region demonstrating significant activity. AR3023 (Dho/βδ) on the southeastern limb may reveal a complex structure as it rotates into a more visible position. The remaining regions are either simple or declining and present a negligible risk of significant flares. No further potentially Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind at L1, has been at ambient levels, below 400km/s with below average density. Total magnetic field strength was mainly weak, but with a slight increase to moderate between 25/0732UTC and 25/1100UTC. During the same period the north-south component, Bz sharply declined to -6nT, with a return to normal conditions characteristic of a weak CME passage. Phi angle was positive (away from the Sun) for much of the period, but rotated to negative orientation from 25/1900UTC. Total geomagnetic activity was Quiet to Unsettled throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has mainly been at moderate levels, with a peak value of 605pfu at 25/1750UTC. Corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a falling trend to reach 2.220e7 integrated pfu at 25/2100UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, but with a risk of further Moderate activity and a very slight risk of High activity. The main source of this heightened risk are two active regions in the northwest quadrant, and one on the southwest limb. The plage region of ex-3016 could also produce further significant flare activity.

Solar Wind / Geomagnetic Activity: A CME which left the southwestern quadrant on 25 May, may arrive at Earth between days 2 and 4, but this is subject to a more detailed analysis as further imagery becomes available. In addition, a slow CME which left the Sun on 23 May, could glance the Earth on 28 May. Solar winds are expected to climb to speeds of 500-550km/s on days 1 and 2 (26 and 27 May) as the Earth connects with a coronal hole high speed stream, most likely from coronal hole 84. Geomagnetic activity is expected to start Quiet, but with an increasing risk of Active or G1/Minor Storm intervals on day 1 due to the high speed stream connection, with a lower risk of these continuing into day 2. A return to Quiet or Unsettled conditions is currently forecast for days 3 and 4, but with a risk of CME arrival through from days 2 to 4.

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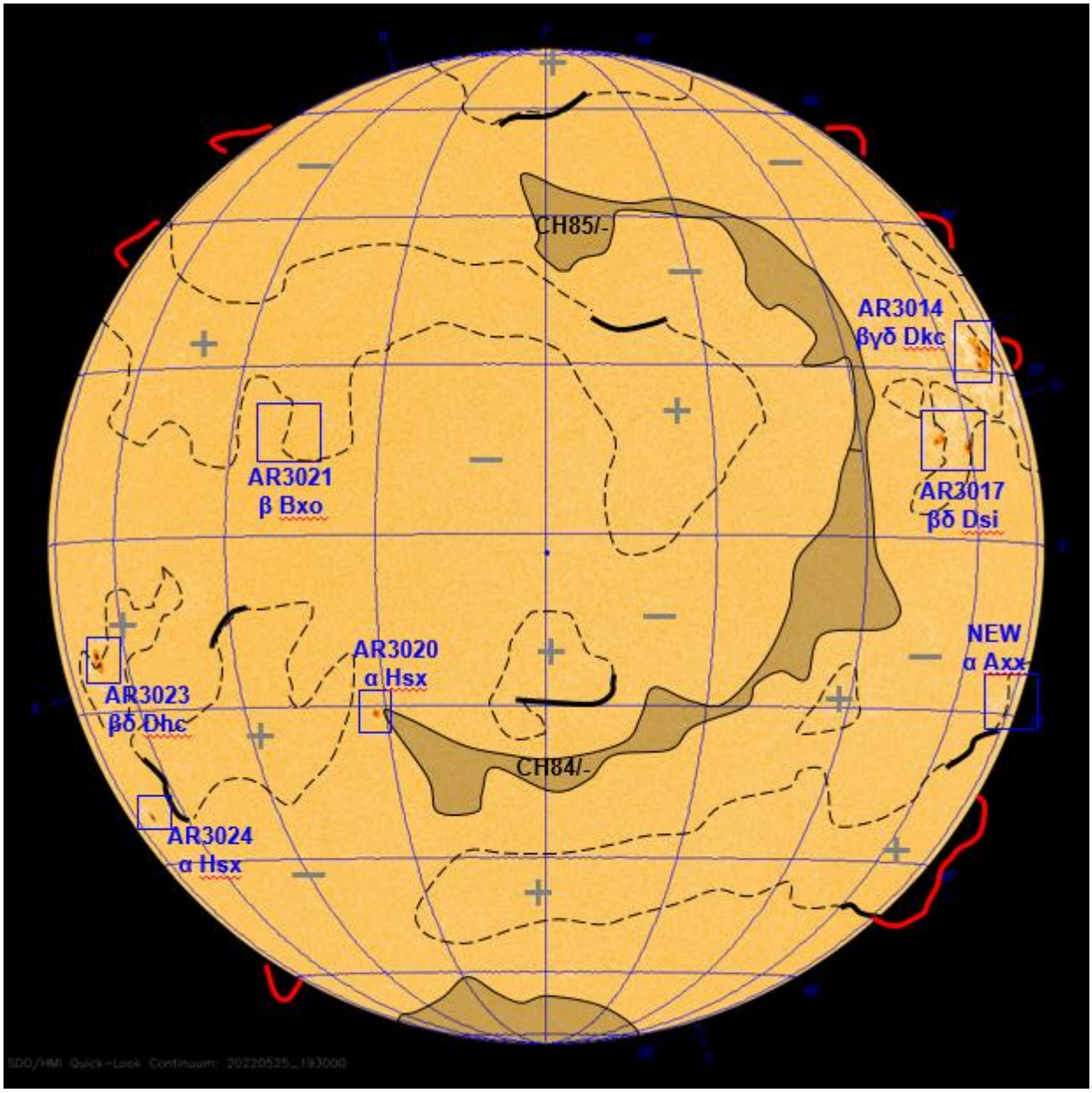
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reaching S1/Minor Storm levels. High energy electron flux (greater than 2MeV) is expected to remain below the high (1e3 pfu) threshold) with the electron fluence remaining below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 25/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently forecast, but a flare from ex-3016 appears to have produced a fast CME which could arrive at the Earth within the forecast period. A full analysis will take place once sufficient imagery is available. In addition, a slow CME which left the Sun on 23 May, may glance the Earth on 28 May.

Coronal hole high speed stream, most likely from coronal hole 84, is expected to connect with the Earth on day 1 (26 May) with speeds of 500-550km/s expected based on persistence. STEREO A is only just connecting with the feature, which would suggest a connection to the high speed stream at Earth in two days. However the observed position and potential speeds indicate a possible earlier connection. Given that the geometry of the coronal hole is on a northwest-southeast axis, any high speed stream is likely to persist through the next four days.

Geomagnetic activity is expected to start at Quiet levels on day 1 (26 May), with an increasing risk of Active intervals or G1/Minor Storms on day 1 and perhaps into day 2 (27 May) depending on the connection to the coronal hole. A return to Quiet or Unsettled conditions is currently forecast for days 3 and 4, but with a risk of potential CME arrivals through days 2 to 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
23/1336	Partial	AR3017	26W 13S	254	28/0300UTC	Limited shock

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Figure 2: SOHO LASCO C2 imagery showing large CME emanating from southwest quadrant. This will be analysed in detail as further imagery become available.

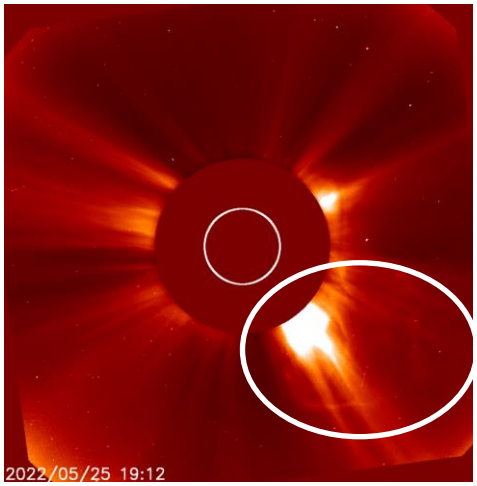
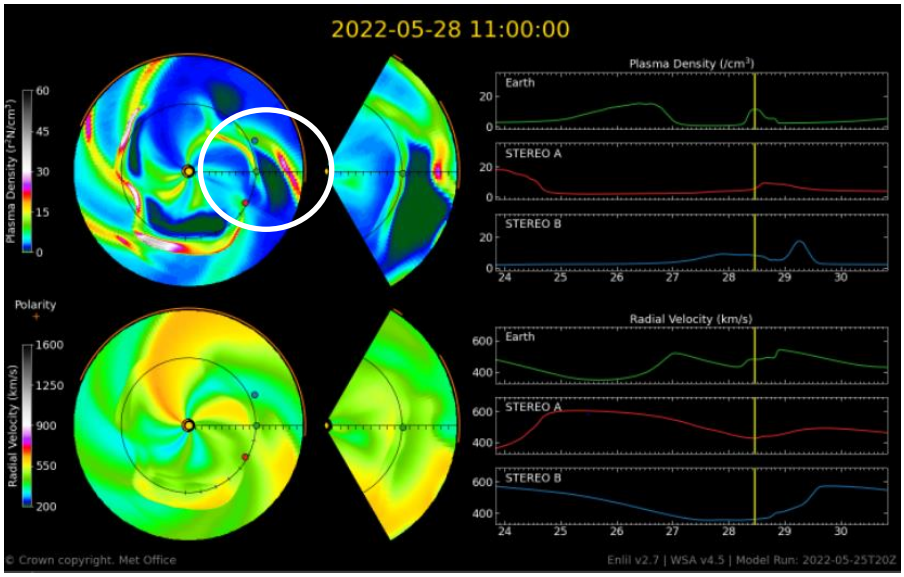


Figure 3: MOSWOC Enlil showing potential arrival time of 23 May CME.



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Radio Blackouts - X-Ray Flares:
Solar activity is Moderate, with one M1.3 flare observed from the region of ex-AR3016 at 25/1824UTC, which produced a likely Earth-directed CME. AR3014 (Dkc/βγδ) has not evolved over the last 24 hours, but has shortened in longitudinal extent. AR3017 (Dsi/βδ) has developed a delta spot in the trailing region but with no further development. These are expected to rotate across the western limb during the next three days, giving a slightly lower risk of M-class and X-class flare activity.

AR3023 (Dhc/βδ), close to the eastern limb is currently difficult to analyse, but observations suggest magnetic complexity which could increase the flare risk as it rotates further into view. No further visible regions are considered to present a significant flare risk, with the most activity from the vicinity of ex-AR3016.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	50	40	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: GOES 16 X-ray flux with the M1.3 flare from ex-AR3016 clearly visible.

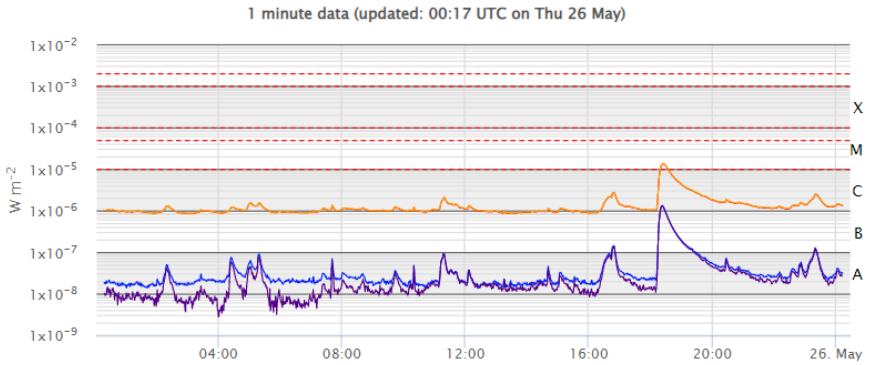

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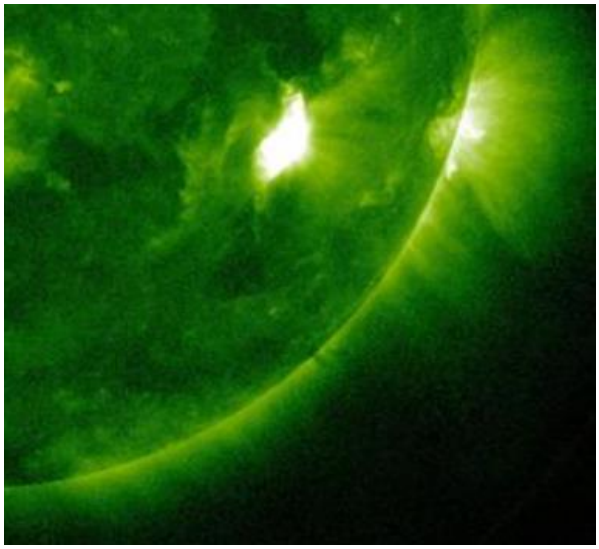
Figure 5: SDO AIA imagery at 25/1844UTC of the M-class flare



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period. There is a slightly increased risk of solar radiation storms through the next three days as regions AR3014 and AR3017 rotate towards the western limb, with this being the prime region for Earth-directed storms. Although these regions are forecast to rotate across the western horizon during day 3, any proton storms from these regions would be visible from over the limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to decline sharply on days 1 and 2 (26 and 27 May) due to potential geomagnetic enhancements, or the speed of a high speed stream which could distort the radiation belts away from GEO orbit. A steady increase towards high (1e3pfu) levels are then expected as the geomagnetic activity subsides, with low confidence for the flux to reach the high threshold. Electron fluence values are likely to follow a downward trend on day 1, then steadily rise as the electron flux increases, but values are unlikely to reach the Active (1e8 integrated pfu) threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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